four kilometres for the convenience of driving the game. There are nearly four hundred lineal kilometres of these rides.

"Mr. Neverli estimates the herd of Bisons at the present time at about seven hundred, and he puts the Elk, which frequent the wettest parts, at the same number. The wild Boars, judging by their frequent rootings, must be very numerous. Red deer were not formerly found in the forest, but have been introduced. I could not find out that there was any satisfactory basis for Mr. Neverli's calculation of the numbers of the herd of Bisons. Judging by the number of tracks which I saw, I am inclined to be sceptical of it. Every naturalist will be anxious to know whether the herd is diminishing or not. Mr. Neverli is of opinion that the herd was formerly more numerous, but such estimates may be based on some calculation even less authoritative than those of the present time.[1] The privilege of hunting in this forest was confined for centuries to the Kings of Poland exclusively."

The following papers were read :—

1. A Contribution to our Knowledge of the Cerebral Convolutions of the Gorilla. By Frank E. Beddard, M.A., F.R.S.

[Received February 7, 1899.]

From a valuable summary of the literature relating to the Gorilla, contributed to 'Natural Science' by Dr. Keith, it appears that no more than twelve brains of this Anthropoid Ape have been submitted to examination. Of these at least that of which some account has been given in the 'Transactions' of this Society by Sir R. Owen was in so poor a state of preservation that not much of value can be deduced from the data.

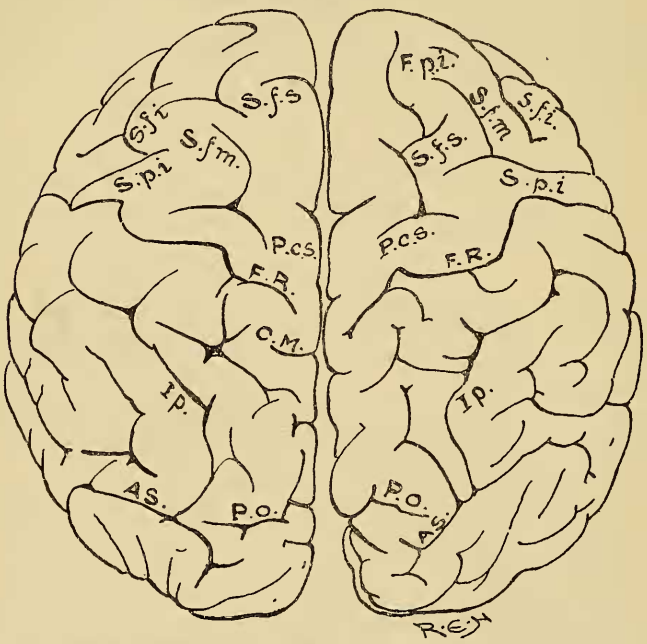
The most elaborate descriptions of the cerebral convolutions of this anthropoid are those of v. Bischoff, Broca, and Chapman, all based, however, on single examples. The specimen studied by v. Bischoff had been previously described and figured (but not explained) by Pansch, a reproduction of which figures, with some comment thereon by Prof. Thane, appeared in vol. xv. of 'Nature.' Other references to Gorilla brains that have been studied will be found in the list of literature with which I conclude the present communication. Some doubt was thrown by v. Bischoff upon the genuineness (as a Gorilla's brain) of the specimen described by Broca; Chapman, however, held that it was certainly a Gorilla's brain, and I associate myself with him in this expression of opinion. All (?) the Gorillas' brains existing in Germany at the time—most, if not all, of which had been previously studied by himself and by Pansch—were brought together and subjected to a

[1] Herr E. Büchner (Mém. Acad. Imp. Sci. St. Pétersb. (8) iii. no. 2) states that the herd in 1856 numbered nearly 1900, and expresses his opinion that the diminution is caused by "breeding-in."

renewed study by v. Bischoff in 1882. There were five brains, but the paper dealing with them was by no means exhaustive, only touching upon certain regions.

This being the state of our existing knowledge of the brain of the Gorilla, I have thought that it would not be a work of supererogation to bring before the Society some notes upon five Gorillas' brains which I have in my possession at the present time. None of these brains have formed the basis of any previous description, so that my contribution to the subject is so far absolutely new. Furthermore, the extent to which the Gorilla's brain has been adequately illustrated is very small: in

Fig. 1.



Brain of Gorilla belonging to Royal College of Surgeons. Dorsal view.

As. Simian fissure. *C.M.* Calloso-marginal. *S.f.s.* Frontalis superior. *S.f.m.* Frontalis medius. *F.p.i.* Part of frontalis superior. *P.o.* Parieto-occipital. *F.R.* Fissure of Rolando. *S.p.i.* Præcentralis inferior. *Ip.* Interparietal. *P.c.s.* Præcentralis superior. *S.f.i.* Frontalis inferior.

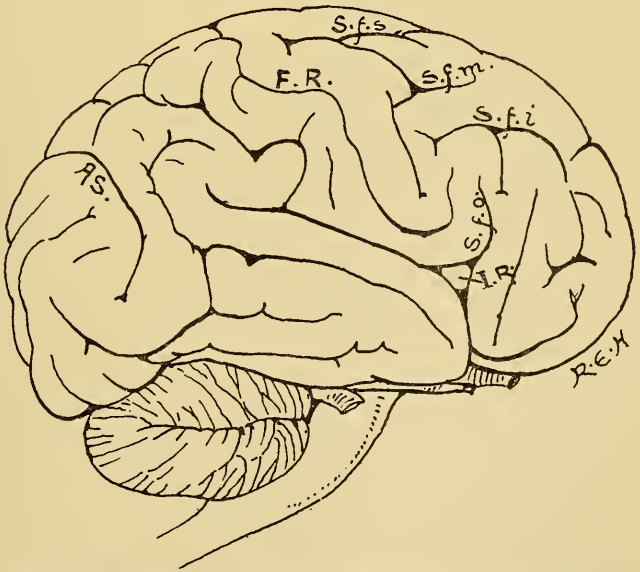
consequence of this deficiency I have thought it advisable to have a number of simple drawings prepared, which are, in my opinion, much more useful than elaborately shaded, but imperfectly lettered, lithographs. My object in this contribution is a very modest one A little too much, perhaps, of elaborate description, comparison and generalization is sometimes based upon inadequate material

this is partly responsible for the enormous brain literature that exists. I propose in the following pages to make my descriptions as short as possible and to forbear from much comment and comparison.

As regards the general shape of the brain, I have no remarks to offer except as to the keel upon the ventral or orbital surface of the frontal lobes. I am disposed to think the existence of this keel is a normal feature of the Gorilla's brain as it is of that of the Chimpanzee. In the two best-preserved brains at my disposal it was very clearly marked. I laid some stress upon the difference in this particular which the brain of "Sally" showed from that of other Chimpanzees. I am now not at all convinced that a larger series would bear out such a distinguishing character. I infer from a remark of Dr. Benham's that the Orang's brain is also believed to be without this keel. The keel was well marked in one of three Orang brains in my possession.

The Sylvian fissure and island of Reil.—The most noteworthy point that I observed in relation to these portions of the brain is

Fig. 2.



Brain of Gorilla belonging to Royal College of Surgeons. Lateral view.

I.R. Island of Reil. *S.f.o.* Fronto-orbitalis.
Other letters as in fig. 1.

the occasional exposure of a portion of the island of Reil. This is seen in fig. 2, which represents one side of the brain belonging to the Royal College of Surgeons. It was visible also on the other side

of this brain. It was visible also in the Oxford brain to about the same extent; and equally clearly in one of the three other brains at my disposal. The appearance of the island of Reil upon the surface of the brain completely shut off by sulci from surrounding regions would thus appear to be a fairly common feature of the Gorilla brain [1].

As to the Chimpanzee, the same exposure of the island at a lower level than the rest of the surface occurred in one of the two brains which I examined. I simply record, as to the Chimpanzee, my own observations without attempting any statistics.

In the brain which I have selected for figuring the exposed island of Reil was exceedingly conspicuous on account of the fact that it is depressed below the surface of the brain and completely surrounded by furrows. It is thus cut off from other gyri in all of the three brains to which reference has just been made. In two of the remaining brains which I have examined the island of Reil appeared at first sight to be not exposed upon the surface of the brain. This appearance I believe to be delusive and to be due to the fact that there is no anterior sulcus dividing off the island from the gyri of the frontal lobe; the level of the island gradually rises and it becomes continuous with a gyrus of the frontal lobe.

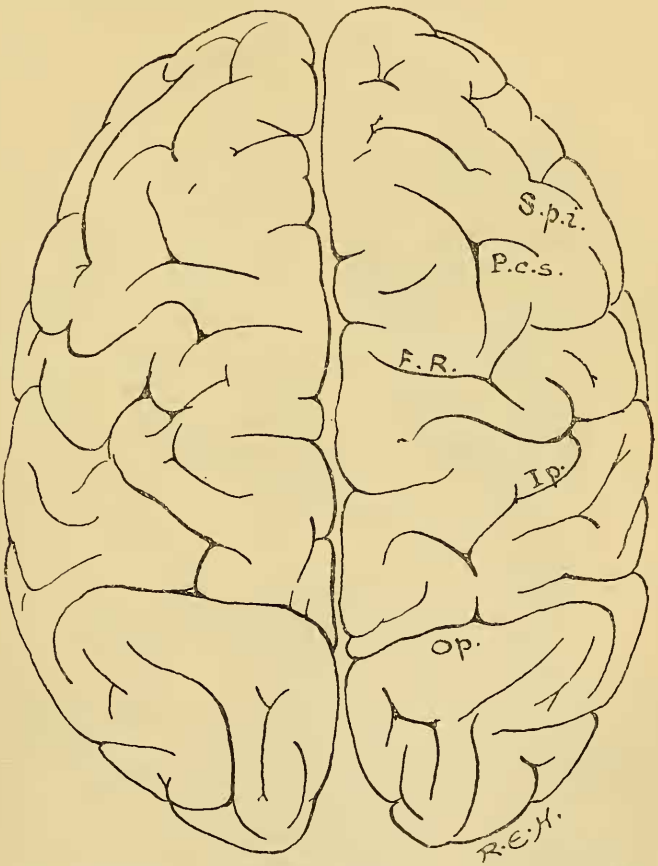
Parieto-occipital fissure.—The Gorilla's brain shows precisely the same variability in the continuity of the fissure separating the parietal and the occipital lobes that is exhibited by the Chimpanzee and the Orang. The operculum, in fact, is not always equally developed. In only one of the five brains at my disposal—that belonging to the University Museum at Oxford (fig. 3)—was the occipital lobe cut off from the parietal by a complete fissure reaching the mesial surface of the brain. The result is, of course, an appearance which is very like that which is so characteristic of the common Chimpanzee. The brain of "Sally," therefore, is so far more like that of the Gorilla. In the four remaining Gorillas' brains there is thus no apparent continuity between the parieto-occipital fissure and the "Affenspalte" or Simian fissure. Between the two is a "pli de passage."

We will commence with some account of the parieto-occipital fissure itself in the four brains where the operculum is absent. The simplest arrangement of this fissure agrees precisely with what Benham has described and figured (15. fig. 21) as the simplest arrangement observable in the Chimpanzee. It is a long fissure showing for about half an inch on the dorsal aspect of the brain; on the mesial surface it runs forwards and is ultimately parallel to the calcarine. I only discovered this simplest state of affairs in two separate half-brains. In the corresponding half to one of these the fissure was the same, excepting for the addition of a forward branch. In the half corresponding to the other of the two brains just mentioned there was an apparent difference of

[1] Dr. v. Bischoff found it in *all* the brains that he examined.

some importance. The Y-shaped fissure was visible on the mesial surface, and *between the forks of the* Y *extended down for a short distance from the upper surface of the brain a fissure.* The arrangement, in fact, is closely like that figured by Benham in figs. 24 and 29 of his paper. I shall follow him in terming the short middle fissure the lateral parieto-occipital and the Y-shaped

Fig. 3.



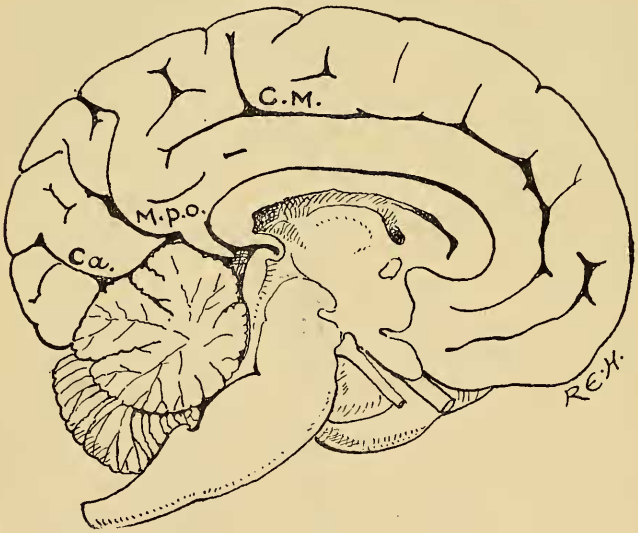
Brain of Gorilla belonging to the University of Oxford. Dorsal view.
Op. Operculum. Other letters as in fig. 1.

fissure the mesial parieto-occipital. I have used the expression "apparent difference" to distinguish this hemisphere from that in which the sum total of the parieto-occipital fissures was represented by one Y for a good reason. When the furrow of that hemisphere is explored by pushing aside its margin a median

lateral parieto-occipital comes into view lying between the two forks of the Y.

In the third brain, as will be seen from the drawings exhibited, the arrangement is practically the same; and one side of the brain belonging to the College of Surgeons (fig. 4) offered no differences. The other side of that brain is not so easy of explanation. It seems, however, to be, like the simplest case, complicated by an additional branch running towards the calcarine.

Fig. 4.



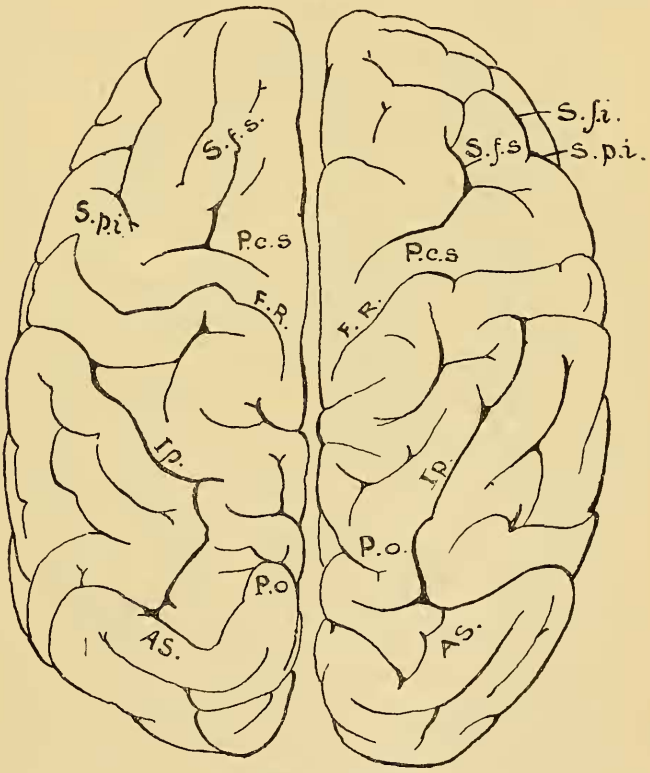
Brain of Gorilla belonging to Royal College of Surgeons. Vertical section.
Ca. Calcarine fissure. *M.p.o.* Mesial parieto-occipital.
C.M. Calloso-marginal.

The Simian fissure.—The Simian fissure, or "Affenspalte" as it is so constantly termed even by English writers, is only hidden by an operculum in one of the five brains at my disposal—that belonging to the Oxford University Museum. In the other brains it is traceable throughout its whole course upon the surface of the brain. This course is roughly obliquely transverse, the fissure bending backwards towards the middle line. It is joined by the intra-parietal fissure at about the middle of its extent. An exceptional state of affairs is seen in the brain represented in fig. 5. Here the fissure on both sides takes a bend forward and reaches the mesial surface, becoming continuous with a portion of the parieto-occipital.

Fissure of Rolando.—Some stress has been laid upon the position of this fissure as marking the posterior boundary of the frontal lobes and as thus determining their relative size. Cunningham

shows from his tables that the position of this fissure in the Chimpanzee and the Orang is a little further behind the middle of the cerebrum than is the case with Man, but that the human fœtus roughly corresponds in these measurements with the adult anthropoid. On the other hand, Benham finds that the fissure of Rolando in the Chimpanzee "Sally" is in front of the middle line. It cannot be said, therefore, that the greater length of the frontal lobe is a character of the Anthropoid Apes as contrasted with Man.

Fig. 5.



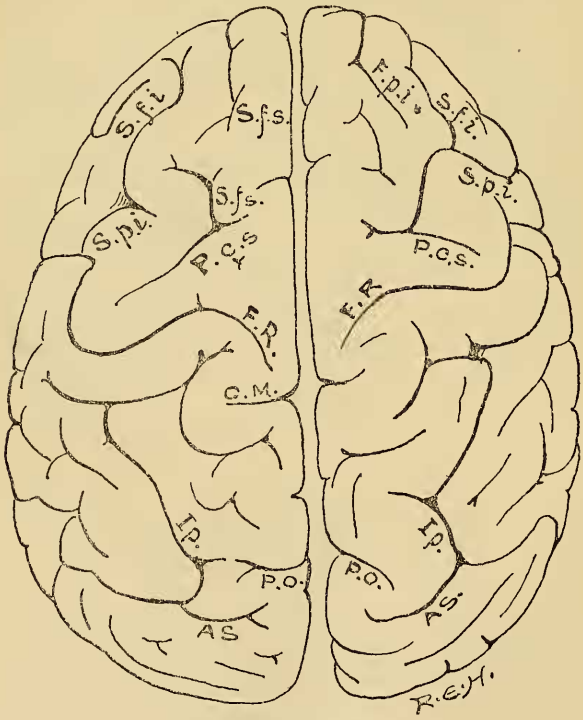
Brain of Gorilla.

Letters as in fig. 1.

One cannot be convinced in spirit-preserved brains that the shrinkage has been uniform. It is doubtful, therefore, how far accurate measurements are of use. But I may observe that in the best-preserved brain at my disposal (fig. 6, p. 72), and in another not quite so good, this fissure was at its posterior end (on the right side; on the left the fissure was a little longer) exactly in the middle of

the antero-posterior diameter of the hemisphere. In the Oxford brain it was most patent, without any measurements at all, that the fissure was much in front of the middle line. Tape measurement gave the total length of a hemisphere as $5\frac{1}{8}$ inches and $2\frac{3}{8}$ the length of the pre-Rolandic portion. This seems too great a difference to be accounted for by defective preservation resulting in unequal contraction. After two such divergent observations it seems to be difficult to deduce any conclusions which bear upon the relative sizes of the two lobes in question. There is evidently much variation.

Fig. 6.



Brain of Gorilla.

Letters as in fig. 1.

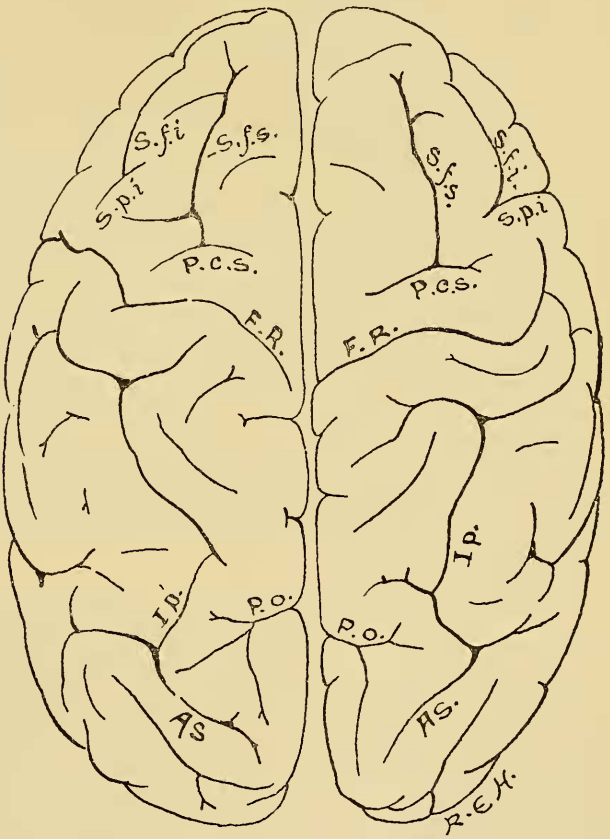
This fissure varies too in its length, sometimes cutting the mesial surface of the brain superiorly and reaching the Sylvian fissure below; it is not always so long.

In only one of the five brains at my disposal (fig. 7) did the Rolandic sulcus actually cut the margin of the brain and disappear from view when the brain was examined from above; this, moreover, was only on the right side. In the other brains were exhibited

various degrees of nearness to this extreme. In two brains, though this fissure was visible in its entirety from above, it did just turn over the border so as to be visible from the mesial side.

It is equally rare for the fissure to reach the Sylvian fissure. In only two half-brains (the right in one case and the left in the other) did this occur.

Fig. 7.



Brain of Gorilla. Dorsal view.
Letters as in fig. 1.

Calcarine fissure.—The extreme difficulty of laying down any laws as to the course of particular fissures from the examination of only a small number of examples is well illustrated by the condition of this fissure in the Anthropoid Apes.

Prof. Cunningham arrived at the conclusion that the junction of this fissure with the parieto-occipital to form a Y-shaped figure was distinctive of Man as opposed to the Anthropoid Apes.

But later Dr. Benham found this precise arrangement in the brain of *Anthropopithecus calvus* and in another Chimpanzee. Whether the Gorilla's brain shows the same variability or not I am unable to state; but at any rate there was no such junction in three of the brains which I examined. On the other hand, in the brain of a common Chimpanzee this junction was obvious on both sides.

Calloso-marginal fissure.—This is long and deeply engraved upon the brain-surface. It follows the margin of the corpus callosum and bends down anteriorly with it. Posteriorly it ends with the corpus callosum. So far there is no difference from the Chimpanzee.

A number of branches arise from the upper margin of the fissure and run at right angles to it towards the upper margin of the brain. Two or three of these actually bend over and appear right and left upon the upper surface of the hemispheres. So far as concerns the parietal lobe, only one of these fissures is absolutely constant; it is to be found in all my five brains. The fissure in question cuts the surface of the brain just behind the fissure of Rolando. Exactly the same statement may be made with regard to the Chimpanzee brain. But there is this difference between the two Anthropoid Apes, that whereas in the Gorilla the calloso-marginal sulcus is continued back behind the point of origin of the transverse fissure just referred to, this is at least not always the case with the Chimpanzee. In two brains of the latter animal which I have before me the calloso-marginal fissure ends in this superficial fissure.

Intra-parietal fissure.—In the Gorilla, as in the Chimpanzee, this is sometimes a continuous and T-shaped fissure. The horizontal part of the T runs roughly—in some cases, indeed, more accurately—parallel to the fissure of Rolando. The stem of the T joins the Simian fissure behind.

Dr. Cunningham divides this complex fissure in the human brain into four separate ones, since in the fœtal brain they are not confluent. In the Gorilla that portion of the system which Cunningham terms "sulcus postcentralis superior," and which lies most mesially of the various component parts, is sometimes separate from the rest. This was the case with the right half of the brain belonging to the College of Surgeons (fig. 1), in which, moreover, the furrow in question was prolonged anteriorly to reach the fissure of Rolando. The same arrangement was observed in the same hemisphere of a second brain (fig. 5) and in the left hemisphere of a third (fig. 7), save that in neither of these was there a junction with the fissure of Rolando. In two other brains these various sections were confluent.

There is thus in the Gorilla precisely the same variability in respect of these fissures that occurs in the Chimpanzee. It is no more the "usual condition" in the Gorilla than it is in the Chimpanzee for the sulcus postcentralis superior to be confluent with the rest of this system of fissures.

Sulci of the frontal lobe.—It may be convenient to describe these furrows in some elaboration in a given brain and then to describe

the divergences from this artificially created normal. For this purpose I shall select the brain belonging to the Royal College of Surgeons.

On the left side of this brain (fig. 1) there is a short *præcentralis superior* roughly parallel to the fissure of Rolando. From it extends forwards the *sulcus frontalis superior*, divided into two by a break and apparently ending anteriorly in a fork; but a short furrow belonging to this system arises between the extremities of the fork and extends forward for a short distance. Again, parallel with the fissure of Rolando, but below the *sulcus præcentralis superior*, is the *sulcus præcentralis inferior*. Of this furrow the *ramus horizontalis* is very oblique and communicates with the fissure of Rolando. From the mesial extremity of the ramus horizontalis arises the very short *sulcus frontulis medius*.

From about the middle of the præcentralis inferior arises the *sulcus frontalis inferior*, which is quite as extensive a furrow as the frontalis inferior. It is roughly parallel to it. The first portion of the furrow forks exactly as does the frontalis superior, and again in the same way the distal part of the furrow arises between the fork. The *sulcus fronto-orbitalis* is continuous with the Sylvian fissure below, and bounds the anterior side of the (here exposed) island of Reil. In front of this is the Y-shaped *sulcus fronto-marginalis*; the stem is perpendicular to the long axis of the hemisphere; finally the pre-Sylvian fissure completes the triangular boundary of the island of Reil.

The right half of this brain shows the following principal differences:—The *frontalis medius* is much longer; the *ramus horizontalis* does not communicate with the fissure of Rolando. The *frontalis inferior* does not communicate with the *præcentralis inferior*.

The *præcentralis superior* nowhere differs greatly from the arrangement which obtains in the brain that has just been described. It never is continuous with the præcentralis inferior as is the case with a Chimpanzee's brain in my possession.

The *frontalis superior* in other brains shows variations in the degree and manner in which it is broken up into segments. Sometimes it is a continuous fissure; this was the case with both sides of one brain and with one side of another. In the right hemisphere of a third brain the first part of this fissure became deflected to the right and joined the præcentralis inferior (fig. 6).

Præcentralis inferior.—In three hemispheres (belonging to different brains), in addition to the College of Surgeons' brain already referred to, the ramus horizontalis cut the Rolandic fissure.

The *sulcus frontalis medius* is not a prominent feature of any of the brains at my disposal. The smallness of its size in the College of Surgeons' brain has been commented upon already; it is present and also small in only one hemisphere out of the four remaining brains examined by me. In the rest I can find no vestige of it. It might possibly be held that the furrow marked *F.p.i*, in fig. 6, is really a portion of the medius. But I think that

the brain illustrated in fig. 1 (p. 66) does away with this supposition, since the fissure which evidently corresponds to *F.p.i.* of fig. 6 is clearly continuous with and a part of the sulcus frontalis superior.

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2. Note on the Presence of Supernumerary Bones occupying the Place of Prefrontals in the Skulls of certain Mammals. By Robert O. Cunningham, M.D., D.Sc., F.L.S., F.G.S., C.M.Z.S., Professor of Natural History, Queen's College, Belfast.

[Received November 21, 1898.]

About two years ago [1] I addressed a brief communication to the Zoological Society on the occurrence of a pair of small bones in the skull of a Lemur, occupying a corresponding position to the prefrontals of a Reptile. In that paper I referred to similar bones having been previously recorded in the skull of a Hippopotamus.

[1] *Cf.* P. Z. S. 1896, p. 996.